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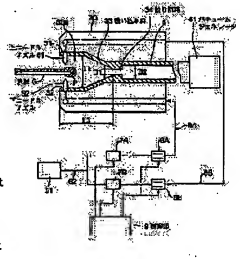
(54) THIN FILM REMOVING METHOD AND DEVICE THEREFOR

(57)Abstract:
PROBLEM TO BE SOLVED: To suppress the degradation in the throughput of removal processing even if a solvent (a solvent having high safety) having a low dissolution capability to a resist is used at the time of removing an unnecessary resist film at the edge of a substrate.
SOLUTION: A substrate G is held on a holding table and is scanned along the edge of the substrate G by a solvent discharge section having upper and lower needle nozzles 51, 52 respectively facing the front surface side and rear surface side at the edge. A prescribed amt. of the solvent is supplied independently to the front surface side and rear surface side at the time of the first scan (first pass). At the time of the second scan, the supply amt. of the solvent on the front surface side is set at the same amt. as the amt. of the first path. The supply amt. of the solvent on the rear surface side is set smaller than the supply amt. of the first time or the supply of the solvent is stopped.



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NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the approach of dissolving with a solvent and removing the unnecessary film of the periphery section of the substrate with which the thin film was formed (a) The process which supplies a solvent independently of each periphery section by the side of the front face of a substrate, and a rear face, (b) The thin film removal approach characterized by providing the process which supplies a solvent by the flow rate smaller than the flow rate supplied to the rear-face side at said process (a) to the periphery section by the side of the rear face of said substrate while supplying the solvent to the periphery section by the side of the front face of said substrate, or suspends supply of a solvent.
[Claim 2] The sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face of the substrate in said process (b) and a rear face is the thin film removal approach according to claim 1 characterized by being fewer than the sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face of the substrate in said process (a), and a rear face.
[Claim 3] The thin film removal approach according to claim 1 characterized by carrying out suction discharge of a solvent and the melt from the side of the periphery section of a substrate, and the method of outside at least in one side among said process (a) and (b).
[Claim 4] Said substrate is the thin film removal approach according to claim 1 characterized by making late passing speed of the solvent supply location concerned when the location on the substrate with which a rectangle configuration is supplied to a solvent at least in one side among nothing, said process (a), and (b) is moved along the side of a substrate and the solvent supply location concerned is located to the field of the corner of a substrate.
[Claim 5] Said substrate is the thin film removal approach according to claim 1 characterized by increasing the supply flow rate of a solvent when the location on the substrate with which a rectangle configuration is supplied to a solvent at least in one side among nothing, said process (a), and (b) is moved along the side of a substrate and the solvent supply location concerned is located to the field of the corner of a substrate.
[Claim 6] The thin film removal approach characterized by supplying a solvent in the approach of dissolving with a solvent and removing the unnecessary film of the periphery section of the substrate with which the thin film was formed, by the flow rate smaller than the flow rate of the solvent supplied to a front-face side to the periphery section by the side of the rear face of said substrate.
[Claim 7] In the approach of dissolving with a solvent and removing the unnecessary film of the periphery section of the substrate with which the thin film was formed Attracting a solvent according to a suction discharge device, while making a solvent breathe out from a solvent discharge part The process which said solvent discharge part and a suction discharge device are made to approach to the periphery section of a substrate relatively, Subsequently, the process which carries out suction discharge of a solvent and the melt according to said suction discharge device while supplying a solvent to the periphery section of a substrate from said solvent discharge part, The thin film removal approach characterized by providing the process which makes said solvent discharge part and a suction discharge

device estrange to the periphery section of a substrate relatively, attracting a solvent according to a suction discharge device while making a solvent breathe out from the account solvent discharge part of back to front.

[Claim 8] In the equipment from which it dissolves with a solvent and the unnecessary film of the periphery section of the substrate with which the thin film was formed is removed The solvent discharge part which supplies a solvent independently of each periphery section by the side of the front face of said substrate, and a rear face, The thin film stripper characterized by providing the control section which switches alternatively whether both front-face and rear-face sides are supplied from said solvent discharge part, or a solvent is supplied only to the front-face side of a substrate from said solvent discharge part.

[Claim 9] The thin film stripper according to claim 8 characterized by the thing which was prepared in the suction exhaust passage which has opening for carrying out suction discharge of a solvent and the melt in the side of a substrate, and the method of outside, and this suction exhaust passage, and which extract and possesses passage.

[Claim 10] Said suction exhaust passage is a thin film stripper according to claim 8 characterized by becoming narrow gradually towards said drawing passage from said opening.

[Claim 11] Said suction exhaust passage is a thin film stripper according to claim 8 characterized by equipping the downstream of said drawing passage with the passage which has the bigger cross section than the cross section of the drawing passage concerned.

[Claim 12] While surrounding front flesh-side both sides and the side edge of the substrate attaching part which holds said substrate in the level condition, and the periphery section of the substrate held at said substrate attaching part through spacing in the equipment from which the unnecessary film of the periphery section of the substrate of a rectangle configuration with which the thin film was formed is removed The solvent discharge part relatively prepared movable with the substrate along with one side of the substrate concerned, The solvent delivery for supplying the solvent for being prepared in said solvent discharge part along with one side of a substrate, and dissolving said thin film to the edge of a substrate, It is prepared in the side side of the side edge of the substrate of said solvent discharge part, and has a suction exhaust air way for attracting and discharging the melt of the thin film by the solvent and the solvent. Said solvent discharge part The thin film stripper characterized by the die length in alignment with one side of the substrate of the passage on the substrate of the solvent supplied from said solvent delivery concerned being 50mm or more while a solvent is supplied by the flow rate of 30 cc [or more]/m from said solvent delivery.

[Claim 13] The tip side of a suction exhaust air way is a thin film stripper according to claim 12 characterized by being formed in the shape of [which becomes large gradually towards a tip opening side] a trumpet.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the thin film stripper for removing the unnecessary resist film of the edge of the LCD substrate of a square shape with which the resist film was formed in the front face.
[0002]
[Description of the Prior Art] Generally, in order to form a thin film, an electrode pattern, etc. of ITO (Indium Tin Oxide) on a LCD substrate (glass substrate) in the production process of liquid crystal display display (LCD) equipment, a circuit pattern etc. is reduced using the same photolithography technique as what is used in a semi-conductor production process, it imprints to a photoresist, and a series of processings which carry out the development of this are performed.
[0003] Where installation immobilization of the LCD substrate (a substrate is told to below) of a square shape is carried out as the formation approach of the resist film on the maintenance means, for example, a spin chuck, arranged in a processing container when the above processings are performed for example Stop opening of a processing container with a lid and a processing container and a spin chuck are rotated. For example, the resist liquid which consists of a solvent and a photopolymer is dropped at the core on this top face of a substrate, and the spreading film formation approach which turns that resist liquid to the periphery section from a substrate core according to the turning effort and the centrifugal force of a substrate, and a radiation castle is made to diffuse, and is applied is learned.
[0004] The phenomenon of becoming thick so that resist liquid may rise in the substrate periphery section by the effect of surface tension, and the phenomenon in which resist liquid turns even to the inferior-surface-of-tongue periphery section of a substrate, and the unnecessary film is formed occur as the time amount after rotation stopped and the centrifugal force stopped working passes, even if the thickness immediately after spreading is uniform in the case of this spreading processing. Thus, if the uneven thick film is formed in the periphery section of a substrate, it will remain without removing the resist of the periphery section completely at the time of development, such as an integrated-circuit pattern, the resist which remained will separate in the conveyance process of a subsequent substrate, and it will become the cause of particle generating.
[0005] So, in the former, after applying resist liquid etc. on the surface of a substrate, processing which removes the unnecessary spreading film of the periphery section of a substrate is performed. As the approach of this processing, as shown, for example in drawing 9 , the method of injecting a solvent for the resist film dissolving in four pieces of edges of Substrate G by the removal nozzle 11 (11a, 11b, 11c, 11d), respectively is learned.
[0006] As the removal nozzle 11 is shown in the sectional view of drawing 13 , and the top view of drawing 14 , it is formed in an abbreviation U shape and Substrate G is arranged to the processing space S of the interior, and the resist film which sprayed the solvent on vertical both sides of Substrate G, respectively, and was dissolved from needle nozzles 12a and 12b, and a solvent are constituted so that it may be discharged outside through the exhaust air way 13 established in the side of Substrate G.

[0007] 27mm and width of face c are set [height a] as 30mm for 3.5mm and depth b, and, as for the processing space S of the removal nozzle 11, the bore is set as 9mm here, as for the exhaust air way 13. Moreover, it is attached in the removal nozzle 11 so that four needle-nozzles of 0.26mm of diameters of opening 12a and four needle-nozzles 12b may inject resist removal liquid in the location of 3-4mm inside from the edge of Substrate G at intervals of 4mm, respectively. In addition, the distance e1 and e2 from the tip of needle nozzles 12a and 12b to Substrate G is set as 1.0mm and about 2.0mm, respectively.

[0008] And carrying out adsorption maintenance of the substrate G, and spraying a solvent by 20 cc flow rate for /on the installation base 14, first, in case this removal nozzle 11 removes the resist film, by 1-round-trip-half-moving the removal nozzle 11 by 60mm/second in rate along with the edge side of Substrate G, respectively, it was made to scan 3 times and the unnecessary resist film by the side of an edge side is removed.

[0009]

[Problem(s) to be Solved by the Invention] By the way, by the above-mentioned approach, as a solvent for removing the resist film from the former, although butyl acetate (NBA), a methyl ethyl ketone (MEK), etc. were used, since the amount which a solvent reveals to an activity ambient atmosphere increases, the inclination for the bad influence to the body to use few safe solvents is increasing in the volume-production facility of a LCD substrate.

[0010] As said safe solvent, the boiling points, such as O.K.73 thinner which mixed polyprene glycol mono-methyl ether (PGME) and polyprene glycol mono-methyl ether acetate (PGMEA) at a rate of PGME:PGMEA=3:7, and 2 heptanone, are as high as 140 degrees C or more here, and volatility can use few solvents.

[0011] However, among these solvents, since O.K.73 thinner had the melting capacity of the resist film smaller than an old thing, the removal engine performance was worse than the conventional solvent, and it was difficult [it] to remove a resist completely only by making the removal nozzle 11 scan 3 times. For this reason, although it must stop having had to increase the count of a scan of the removal nozzle 11, even if it enlarged scan speed at this time, the time amount which removal processing takes had the problem that will become long and the throughput of the whole formation processing of the resist film will worsen as a result rather than before.

[0012] This invention is made under such a situation, and in removing the unnecessary thin film of the edge of a substrate using the solvent in which a thin film is dissolved, even if the low solvent (insurance solvent) of melting capacity is used for the purpose, it is to offer the technique in which the fall of the throughput of removal processing of the thin film concerned can be suppressed.

[0013]

[Means for Solving the Problem] In the approach of invention of claim 1 dissolving with a solvent the unnecessary film of the periphery section of the substrate with which the thin film was formed, and removing (a) The process which supplies a solvent independently of each periphery section by the side of the front face of a substrate, and a rear face, (b) While supplying a solvent to the periphery section by the side of the front face of said substrate, it is characterized by providing the process which supplies a solvent by the flow rate smaller than the flow rate supplied to the rear-face side at said process (a) to the periphery section by the side of the rear face of said substrate, or suspends supply of a solvent.

[0014] In this case, it can more specifically consider as the following technique. There is less sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face of the substrate in said process (b) and a rear face than the sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face of the substrate in said process (a), and a rear face. At least in one side, suction discharge of a solvent and the melt is carried out from the side of the periphery section of a substrate, and the method of outside among said process (a) and (b). When the location on the substrate with which a rectangle configuration is supplied to a solvent at least in one side among nothing, said process (a), and (b) is moved along the side of a substrate and the solvent supply location concerned is located to the field of the corner of a substrate, said substrate makes late passing speed of the solvent supply location concerned, or increases the supply flow rate of a solvent.

[0015] Invention of claim 6 is characterized by supplying a solvent by the flow rate smaller than the flow rate of the solvent supplied to a front-face side to the periphery section by the side of the rear face of said substrate in the approach of dissolving with a solvent and removing the unnecessary film of the periphery section of the substrate with which the thin film was formed.
[0016] In the approach of invention of claim 7 dissolving with a solvent the unnecessary film of the periphery section of the substrate with which the thin film was formed, and removing Attracting a solvent according to a suction discharge device, while making a solvent breathe out from a solvent discharge part The process which said solvent discharge part and a suction discharge device are made to approach to the periphery section of a substrate relatively, Subsequently, the process which carries out suction discharge of a solvent and the melt according to said suction discharge device while supplying a solvent to the periphery section of a substrate from said solvent discharge part, It is characterized by providing the process which makes said solvent discharge part and a suction discharge device estrange to the periphery section of a substrate relatively, attracting a solvent according to a suction discharge device, while making a solvent breathe out from the account solvent discharge part of back to front.
[0017] In the equipment which the equipment (claim 8) of this invention dissolves with a solvent the unnecessary film of the periphery section of the substrate with which the thin film was formed, and is removed The solvent discharge part which supplies a solvent independently of each periphery section by the side of the front face of said substrate, and a rear face, It is characterized by providing the control section which switches alternatively whether both front-face and rear-face sides are supplied from said solvent discharge part, or a solvent is supplied only to the front-face side of a substrate from said solvent discharge part.
[0018] In this case, the thing which was prepared in the suction exhaust passage which has opening for carrying out suction discharge of a solvent and the melt in the side of a substrate and the method of outside, and this suction exhaust passage and which extract and possesses passage is desirable. Moreover, as for said suction exhaust passage, it is desirable to become narrow gradually towards said opening to said drawing passage, and it is [said suction exhaust passage] still more desirable to equip the downstream of said drawing passage with the passage which has the bigger cross section than the cross section of the drawing passage concerned. In the equipment from which the equipment (claim 12) of other invention removes the unnecessary film of the periphery section of the substrate of a rectangle configuration with which the thin film was formed While surrounding front flesh-side both sides and the side edge of the substrate attaching part which holds said substrate in the level condition, and the periphery section of the substrate held at said substrate attaching part through spacing The solvent discharge part relatively prepared movable with the substrate along with one side of the substrate concerned, The solvent delivery for supplying the solvent for being prepared in said solvent discharge part along with one side of a substrate, and dissolving said thin film to the edge of a substrate, It is prepared in the side side of the side edge of the substrate of said solvent discharge part, and has a suction exhaust air way for attracting and discharging the melt of the thin film by the solvent and the solvent. Said solvent discharge part While a solvent is supplied by the flow rate of 30 cc [or more]/m from said solvent delivery, it is characterized by the die length in alignment with one side of the substrate of the passage on the substrate of the solvent supplied from said solvent delivery concerned being 50mm or more. In this case, as for the tip side of a suction exhaust air way, it is desirable to be formed in the shape of [which becomes large gradually towards a tip opening side] a trumpet.
[0019]
[Embodiment of the Invention] By attaining optimization of the configuration of the solvent discharge part of a thin film stripper, this invention raises the removal engine performance of a thin film, for example, the resist film, and raises the throughput of removal processing of the resist film concerned. Under the present circumstances, when developing the structure of the solvent discharge part which raises the removal engine performance of O.K.73 thinner with the lowest removal capacity among the solvents of various resist film, this invention persons think that the high equipment of versatility applicable to various solvents is obtained, and came to complete this invention.
[0020] Based on drawing 1 -4, the gestalt of 1 operation of the thin film stripper of this invention is

explained first. The maintenance base 2 which makes the substrate attaching part which this equipment carries out vacuum adsorption of the inferior surface of tongue of Substrate G, for example, a rectangular LCD substrate, and holds the substrate G concerned at a horizontal (a horizontal is also mostly included with the horizontal as used in the field of this application), It has the 4th solvent discharge part 3 (3a-3d). four the 1- for spraying a solvent on the edge of four sides of the substrate G held on this maintenance base 2 (field to the location which visited the center somewhat from the edge) - - These solvents discharge part 3 is formed in the cross direction (x directions) of Substrate G, the die-length direction (the direction of y), and the height direction (the direction of z) free [migration].

[0021] The upper needle nozzle 51 for solvent regurgitation and the bottom needle nozzle 52 by which said solvent discharge part 3 was established in the top-face section 31 and the inferior-surface-of-tongue section 32 which counter **, and these top-faces section 31 and the inferior-surface-of-tongue section 32, respectively, The absorption opening 33 which makes a part of suction exhaust air way formed so that opening might be carried out so that the end face side of the top-face section 31 and the inferior-surface-of-tongue section 32 may be attended at space 33a between these, and the diameter might be reduced in the shape of a trumpet from the opening, It has the diaphragm passage (orifice passage) 34 which is open for free passage to the end face side of this suction opening 33, and the steady flow way 4 which is open for free passage to this drawing passage 34 and where a cross-section configuration is circular, for example, and a part of steady flow way 4 is covered by the block 30 which makes the sheathing section from the top-face section 31 and the inferior-surface-of-tongue section 32.

[0022] Said upper needle nozzle 51 and the (bottom needle nozzle 52) are connected to solvent supply way 6A (6B) which consists of a tube through passage 51a (52a) formed in the block 30. These solvents supply ways 6A and 6B have branched from the common solvent supply way 62 which an end opens for free passage to the solvent source of supply 61, and flow-control-valve 7A (7B) and air operation bulb 8A (8B) are prepared in solvent supply way 6A (6B) which is branching Rhine at this order. In addition, actuation of flow control valves 7A and 7B and air operation bulb 8A (8B) can be independently controlled now by the control section 9, respectively.

[0023] Four up-and-down needle nozzles 51 and 52 are formed at a time, respectively, as shown in drawing 3 , and the delivery of the upper needle nozzle 51 and the delivery of the bottom needle nozzle 52 are alternately arranged so that it may not face each other on a straight line. And if the periphery section of Substrate G is located among needle nozzles 51 and 52 up and down as shown in drawing 2 , the delivery of the upper needle nozzle 51 will meet the front face of Substrate G, and the delivery of the bottom needle nozzle 52 will meet the rear face of Substrate G. In this case, the delivery of the vertical needle nozzles 51 and 52 counters the location which came together for example, in the center of 3-4mm from the edge of Substrate G. In addition, the distance from the delivery of the upper needle nozzle 51 to the front face of Substrate G is set as about 1.0mm, and the distance from the delivery of the bottom needle nozzle 52 to the rear face of Substrate G is set as about 1.0mm, respectively. Moreover, the bore of the delivery of the vertical needle nozzles 51 and 52 is about 0.26mm.

[0024] Space 33a between said top-face section 31 and the inferior-surface-of-tongue section 32, the trumpet-like suction opening 33, the diaphragm passage 34, and the steady flow way 4 make the suction exhaust air way for attracting and collecting solvents, and the vacuum generator (evacuation equipment) 41 is formed in the steady flow way 4. In addition, the member which constitutes a suction exhaust air way is equivalent to a suction exhauster style. In this case, it is desirable to set the height L1 of space 33a, i.e., the clearance of the top-face section 31 and the inferior-surface-of-tongue section 32, as 50-100mm, and to set width of face L2 as 25-100mm, respectively. Moreover, it extracts from the tip of the top-face section 31 and the inferior-surface-of-tongue section 32, and, as for the direction distance L3 of X to the entry of passage 34, it is desirable to set it as 25-200mm. Said drawing passage 34 is making the square shape, and it is desirable to set the diameter medianus D1 as 6-11mm, and to set the transverse diameter D3 as 11-60mm. Moreover, as for the path D2 of the steady flow way 4, it is desirable to be referred to as 12mm or more. Furthermore, tip opening (**** opening) of the trumpet-like suction opening 33 is located in the place which went for example, into about 4mm back from the tip of the top-face section 31 (inferior-surface-of-tongue section 32) again.

[0025] In such a thin film stripper, it is carried in by the conveyance arm which the substrate G with which resist liquid was applied by for example, SUPINKO-TINGU, and the resist film was formed in the front face does not illustrate (process S1), and it is laid on the maintenance base 2 and suction maintenance is carried out (process S2).
[0026] While turning the solvent discharge parts 3a-3d to an operating location and beginning to move them from a home location, the suction exhaust air in each solvent discharge part 3a-3d is started with the vacuum generator 41, respectively (process S3). Regurgitation initiation of the solvent is carried out by 30 cc flow rate for /from the vertical nozzles 51 and 52, respectively (process S4). Making a solvent breathe out, all the solvent discharge parts 3a-3d are made to approach the periphery section of Substrate G, and as shown in drawing 2 , each nozzles 51 and 52 are located in the periphery section of Substrate G (process S5). As succeedingly shown in drawing 1 , along with each sides G1 and G2 of Substrate G, G3, and G4, scanning migration of the solvent discharge parts 3a-3d is carried out, and paint film removal actuation of an one-pass eye is started (process S6). While dissolution removal of the paint film P (refer to drawing 2) is carried out by the 1st and 3rd solvent discharge parts 3a and 3c from the substrate shorter side G1 and the periphery section of G3, dissolution removal of the paint film P is carried out by the 2nd and 4th solvent discharge parts 3b and 3d from the periphery section of the substrate long sides G2 and G4. The solvent of a resist melt and a surplus passes along a suction exhaust air way, that is, suction exhaust air is carried out at the vacuum generator 41 through space 33a, the absorption opening 33, the diaphragm passage 34, and the steady flow way 4.
[0027] If the 1st and 3rd solvent discharge parts 3a and 3c reach the substrate shorter side G1 and the termination (corner section) of G3, these scanning migration will be stopped (process S7). Make scanning passing speed late or make it make it in addition, more desirable for the solvent amount of supply (flow rate) to increase as the 1st and 3rd solvent discharge parts 3a and 3c become close to a shorter side G1 and the termination of G3. Since its solvent amount of supply per unit area of a paint film will increase if it is carried out in this way, since the paint film of the corner section of Substrate G is thicker than other parts, thick paint film 9b becomes is easy to be removed from the corner section of Substrate G. Subsequently, a solvent retreats the 1st and 3rd solvent discharge parts 3a and 3c with discharge, and nozzles 51 and 52 are made to estrange from the shorter side G1 of Substrate G, and G3 (process S8). Subsequently, the regurgitation of the solvent from a shorter side G1 and the nozzles 51 and 52 in G3 is stopped (process S9), and the suction exhaust air in a shorter side G1 and G3 is stopped further (process S10).
[0028] Make scanning passing speed late or it is made to increase the solvent amount of supply as it becomes close to the termination of the substrate long sides G2 and G4 also in the 2nd and 4th solvent discharge parts 3b and 3d, and paint film removal of an one-pass eye is completed in the place where these reached the termination of long sides G2 and G4 (process S11). Moreover, after making nozzles 51 and 52 estrange from the long sides G2 and G4 of Substrate G, the regurgitation of a solvent is stopped and suction exhaust air is stopped.
[0029] The solvent discharge parts 3a and 3c approach the periphery section of Substrate G, moving along the Rhine top extended in the axis of X in alignment with a shorter side G1 and G3, i.e., the direction, and are estranged from the periphery section of Substrate G along the Rhine concerned here. That is, a series of motions of the solvent discharge parts 3a and 3c become what met in a straight line. If it moves in the direction of Y temporarily in the solvent discharge parts 3a and 3c, and the square corner section of the periphery section of Substrate G is made to approach, and it moves subsequently to the direction of X and is made to estrange in the direction of Y from Substrate G, since a motion of the solvent discharge parts 3a and 3c will become a right angle, Since it becomes the appearance which the solvent discharge parts 3a and 3c stopped in the right-angle point and a solvent is intensively supplied by one point, there is a possibility that a solvent and a melt may disperse on a substrate. On the other hand, such fault is avoided by moving the solvent discharge parts 3a and 3c along with a straight line. In addition, it moves on a straight line along Rhine (Rhine extended in the direction of Y) which met long sides G2 and G4 similarly also about the solvent discharge parts 3b and 3d.
[0030] suction exhaust air [in / after that / the solvent discharge parts 3a and 3c] -- resuming (process

S12) -- the regurgitation of the solvent in the solvent discharge parts 3a and 3c is resumed (process S13). Making a solvent breathe out from nozzles 51 and 52, the 1st and 3rd solvent discharge parts 3a and 3c are made to approach the periphery section of Substrate G, respectively (process S14), and as shown in drawing 1 , each nozzles 51 and 52 are located in the periphery section of Substrate G.

[0031] Subsequently, motorised [which it does not illustrate for performing the scan of the solvent discharge parts 3a-3d] is changed to the reverse sense, scanning migration of the solvent discharge parts 3a-3d is carried out at the same rate as the passing speed of an one-pass eye along with each sides G1 and G2 of a substrate, G3, and G4, and paint film removal actuation of a two pass eye is started (process S15). In addition, the 1st and 3rd solvent discharge parts 3a and 3c are turned up in the place which went too far beyond the shorter side G1 of Substrate G, and G3, and turn up the 2nd and 4th solvent discharge parts 3b and 3d in the place which went too far beyond the long sides G2 and G4 of a substrate, respectively. namely, the 1- a solvent discharge part [4th /a / 3 /-3d] clinch point is located in a way outside Substrate G.

[0032] If the 1st and 3rd solvent discharge parts 3a and 3c reach the substrate shorter side G1 and the termination (corner section) of G3, these scanning migration will be stopped (process S16). In addition, passing speed of a scan is made late or the solvent amount of supply is increased as the solvent discharge parts 3a and 3c become close to said termination also in this case. Subsequently, a solvent retreats the 1st and 3rd solvent discharge parts 3a and 3c with discharge, and nozzles 51 and 52 are made to estrange from the shorter side G1 of Substrate G, and G3 (process S17). Subsequently, the regurgitation of the solvent from a shorter side G1 and the nozzles 51 and 52 in G3 is stopped (process S18), and the suction exhaust air in a shorter side G1 and G3 is stopped further (process 19).

[0033] In paint film removal actuation of a two pass eye, the regurgitation of the solvent from the bottom nozzle 52 is stopped, or the discharge quantity of a solvent is sharply decreased to a part for ten cc/. In addition, the discharge quantity of the solvent from the upper nozzle 51 maintains a part for 30 cc/as it is.

[0034] Make scanning passing speed late or it is made to increase the solvent amount of supply as the 2nd and 4th solvents 3b and 3d become close to the termination of the substrate long sides G2 and G4, and discharging of a solvent is stopped in the place where these reached the termination of long sides G2 and G4, and paint film removal of a two pass eye is terminated (process S20). Subsequently, all of suction exhaust air actuation of the solvent discharge parts 3a-3d are stopped (process S21), and all the solvent discharge parts 3a-3d are made to shunt an operating location in a home location (process S22). The maintenance base 2 is raised after an appropriate time, and adsorption of Substrate G is canceled (process S23). And Substrate G is taken out from the thin film stripper concerned by the conveyance arm which is not illustrated (process S24). The processing time which 1 cycle from the above process S1 to a process S24 takes is for about 34 seconds.

[0035] Then, circumstances are explained [which came to complete this invention]. Like previous statement although [this invention persons / using O.K.73 thinner as a solvent] optimization of the configuration of the solvent discharge part 3 is attained and the removal engine performance of the resist film is raised, when the amount of a solvent increased first at this time, they thought that the removal engine performance of a resist improved, and decided to attain optimization of the flow rate of a solvent.

[0036] For this reason, using the thin film stripper equipped with the above-mentioned solvent discharge part 3, the amount of discharge flow of O.K.73 thinner which is a solvent was changed, and removal processing of the substrate G of 650mmx650mm magnitude was performed. The path D2 of 30mm and the steady flow way 4 sets to about 7 micrometers, and the width of face (in detail width of face L2 of the tip edge of the top-face section 31 and the inferior-surface-of-tongue section 32) of the solvent discharge part 3 is [the thickness of 9mm and the resist film] 2.5 - 3 kgf/cm2 to the vacuum generator 42 here. Air was supplied by the pressure and differential pressure in the steady flow way 4 was set to -18 - -20mmHg.

[0037] And the solvent discharge part 3 was made to scan 3 times by 60mm/second in rate along the die-length direction of the long side of Substrate G, removal processing was performed, and the removal

engine performance of the resist film (paint film P) was checked after processing termination. The removal engine performance of the resist film wiped off the front face and end face of Substrate G after processing termination with the cloth in which the acetone was included, and performed them by checking how many resist film remain on Substrate G with the amount of the resist film adhering to the cloth concerned here.

[0038] Although this result is shown in drawing 6 , the condition that, as for O, the resist film was removed completely, the condition that, as for O, the resist film was almost removed, and the condition that, as for **, the resist film remains are shown among evaluations of the removal engine performance of the resist film in drawing, respectively. when it was admitted that the removal engine performance of the resist film would become high if the flow rate of a solvent increases more than this result and the flow rate increased with a part for 50 cc/, it was admitted that it could come out and perform removing most resist film with three scans (three pass).

[0039] However, when the flow rate of the place which observed the front face of Substrate G visually, and a solvent increased at the time of an experiment, the solvent and the melt of the resist film piled up and remained on Substrate G, without carrying out suction exhaust air, and the phenomenon of being in the condition of having got wet without a substrate G front face's getting dry was seen. For this reason, it thought that these holdups had barred removal of the resist film, and examined whether what we would do with the suction exhaust air of said holdup.

[0040] It noted enlarging width of face of the passage on the substrate concerned of the solvent supplied on Substrate G by enlarging width of face L2 of the point of a solvent discharge part with the increment in a flow rate first. For this reason, using the thin film stripper equipped with the above-mentioned solvent discharge part 3, other conditions changed the width of face L2 of the point of a solvent discharge part, and the flow rate of a solvent as the same, and performed removal processing, and it checked by the same approach whether the melt of a solvent and the resist film would remain in Substrate G after processing termination.

[0041] The solvent supplied on Substrate G from the needle nozzle 51 here is absorbed from Substrate G, is absorbed in opening 33, spreading in concentric circular from the location on the substrate G which corresponds to drawing 3 with the tip of a needle nozzle 51 as an alternate long and short dash line shows, and flows towards the steady flow way 4. That is, the width of face of the passage of a solvent here means the die length of the cross direction (the direction of y) of the passage of the solvent which spread in concentric circular on Substrate G, and it is equivalent to the width of face L2 of the point of the solvent discharge part 3 in this drawing.

[0042] The experimental result which measures optimization with said width of face L2 and supply flow Q of a solvent and which went to accumulate is shown in drawing 7 . Even if it was admitted that the removal engine performance of the resist film (paint film P) became high, and the flow rate of a solvent was about 30cc/minute when especially the width of face L2 was 50mm or more so that the width of face L2 of a solvent discharge part became large by this, when the flow rate of a solvent was the same, it was checked that most resist film is removable. Thus, it is guessed that the removal engine performance of the resist film will increase because it becomes easier to exhaust since the width of face of the passage of a solvent becomes large and an exhaust air field becomes large if width of face L2 of the solvent discharge part 3 is enlarged. Moreover, when the width of face L2 of a solvent discharge part was 50mm by observing this experiment visually, it was checked that the die length of the cross direction (the direction of y) of the passage of the solvent which spread in concentric circular on Substrate G is 50mm or more.

[0043] However, since residue was somewhat observed on Substrate G even if it enlarged width of face L2 of the solvent discharge part 3 50mm or more, it noted enlarging suction pressure and raising the suction exhaust air force of the melt of a solvent or the resist film to a degree. For this reason, using the thin film stripper equipped with the above-mentioned solvent discharge part 3, suction pressure was changed and removal processing of said substrate G was performed. The width of face L2 of the solvent discharge part 3 considered the flow rate of 50mm and a solvent as a part for 30 cc/, other conditions performed removal processing as the same, and it checked by the same approach whether the melt of a

solvent and the resist film would remain in Substrate G after processing termination here.
[0044] however, the pressure of the air supplied to the vacuum generator 41 -- 3.5 - 4 kgf/cm2 ****** -- even if it enlarged differential pressure in the steady flow way 4 with -23 - -26mmHg, said residue was observed on Substrate G. Although this has the large suction exhaust air force in the field near the steady flow way 4 since exhaust velocity only changes and an exhaust air field does not become large even if it enlarges only suction pressure, in a distant field, the suction exhaust air force becomes small and it is guessed in the distant field concerned that it is because the suction exhaust air of the melt of a solvent or the resist film is hard to be carried out.
[0045] Then, by enlarging the path D2 of the steady flow way 4 continuously, it noted enlarging an exhaust air field. For this reason, using the thin film stripper equipped with the above-mentioned solvent discharge part 3, the path D2 of the steady flow way 4 was changed, and removal processing of said substrate G was performed. In the width of face L2 of the point of the solvent discharge part 3, the differential pressure of a part for /and 30 cc steady flow way 4 set the flow rate of 50mm and a solvent to -35 - -40mmHg, other conditions performed removal processing as the same, and it checked by the same approach whether the melt of a solvent and the resist film would remain in Substrate G after processing termination here.
[0046] A tone poor result is shown per [at the time of extracting to drawing 8 and changing variously the path D2 of the steady flow way 4 for the path (orifice bore) D1 of passage 34 as constant value (1= 9mm of D)] paint film removal engine performance. Moreover, a tone poor result is shown per [at the time of extracting the path D2 of the steady flow way 4 to drawing 9 as constant value (2= 12.6mm of D), and changing the path D1 of passage 34 variously] paint film removal engine performance. It became clear that the combination which extracts from these results, sets passage 34 path D1 to 9mm, and sets the path D2 of the steady flow way 4 to 12.6mm is the optimal.
[0047] As mentioned above, since the paint film removal engine performance is influenced of the rate of flow of the air at the time of suction exhaust air, it is important to optimize the rate of flow of exhaust air air. With the gestalt of above-mentioned operation, while extracting in the middle of a suction exhaust air way and forming passage 34, since that downstream is expanded and is open for free passage on the steady flow way 4, the differential pressure before and behind the diaphragm passage 34 is high, for this reason, the rate of flow of exhaust air increases, and its paint film removal engine performance improves. And since the suction exhaust air way is formed as trumpet-like suction opening with which it extracts from the field which attends the periphery section of Substrate G, and the cross section becomes narrow gradually up to passage 34, it is discharged smoothly and quickly, without a solvent and a melt piling up on a substrate and in a path. In addition, when passage is narrowed [near the nozzles 51 and 52], the passage of near of nozzles 51 and 52 itself becomes narrow, and displacement cannot be secured, but it further becomes easy to generate the membranous remains of the extrusion, but in this application, since such fault is avoided, it is effective structure.
[0048] When the differential pressure in the steady flow way 4 was furthermore changed, removal processing was performed similarly and the removal engine performance was checked by the same approach, even if the result shown in drawing 10 was obtained and the path D2 of the steady flow way 4 was 12mm or more by this, when the differential pressure in the steady flow way 4 was small, it was checked that the suction exhaust air of the melt of a solvent and the resist film is hard to be carried out.
[0049] Furthermore, the solvent discharge quantity (a part for cc/) of a two pass eye was variously changed by the front-face [of a substrate], and rear-face side, removal processing of a paint film P was performed, and when the same approach estimated each paint film removal engine performance, the result shown in drawing 11 was obtained. or it will, from now on, make the solvent amount of supply of the two pass eye by the side of a rear face fewer than that of an one-pass eye, maintaining similarly to it (a part for 30 cc/) of an one-pass eye the solvent amount of supply of the two pass eye by the side of a front face so that clearly (the approach of a number 5) -- or the solvent supply by the side of a rear face -- stopping (the approach of a number 2) -- it became clear that the paint film removal engine performance improved. In addition, although two pass eyes are the same conditions as an one-pass eye by the approach of a number 1, the paint film removal engine performance is inferior to it of the

approach of a number 2 and a number 5. Moreover, by the approach of a number 3, supply of the solvent of the two pass eye by the side of a front face is suspended, and the solvent amount of supply of the two pass eye by the side of a rear face is maintained similarly to it (a part for 30 cc/) of a two pass eye. Moreover, only suction exhaust air is performed by the approach of a number 4, without a front rear face supplying a solvent to a two pass eye. By the approach of these numbers 3 and 4, neither has removed the paint film P.

[0050] As a result of repeating the above trial-and-error, when the solvent of ether systems, such as O.K. thinner, was used as a solvent, and considering the amount of discharge flow of the solvent from the solvent discharge part 3 as the above by 30 cc/and setting the width of face L2 of the passage on the substrate of a solvent as 50mm or more, it was checked that most resist film is removable. Under the present circumstances, it was checked in the path D2 of a steady flow way 12mm or more, then that the removal engine performance of the resist film becomes high further.

[0051] Then, in order to check the versatility of the thin film stripper using this solvent discharge part 3, As a solvent, the solvent of ether systems, such as PGMEA (propylene-glycol-monomethyl-ether acetate), Butyl acetate (NBA), a methyl ethyl ketone (MEK), and 2 heptanone are used. If the amount of discharge flow of the solvent from the solvent discharge part 3 is considered as the above by 30 cc/and the width of face L2 of the solvent discharge part 3 is set as 50mm or more when removal processing of the resist film of the edge of Substrate G is performed It was checked that any solvent can remove the unnecessary resist film of a substrate edge completely, and it was checked in the path D2 of the steady flow way 4 12mm or more, then that the removal engine performance of the resist film increases further.

[0052] According to the gestalt of above-mentioned operation, by supplying a solvent by the predetermined flow rate from front flesh-side both sides of the periphery section of a substrate, most resists were removed and the remaining resist is removed in a two pass eye by the one-pass eye. And since the supply flow rate of the solvent by the side of a rear face was lessened by the two pass eye or supply of a solvent is suspended, the membranous removal engine performance is high so that the example of an experiment may also show. This reason is considered that a rear-face side can prevent membranous stagnation by processing like the gestalt of this operation although the film which once carried out dissolution dissociation will pile up when the amount of a solvent is made [many] by the two pass eye since there are few amounts of a resist.

[0053] Furthermore, as for a thin film stripper, it is desirable to be accompanied by suction exhaust air as mentioned above again. Namely, operation of sucking out the paint film which dissolved by the one-pass eye is stronger than operation of melting a paint film by the two pass eye. Therefore, the amount of the solvent by which the film in which the excessive solvent on the contrary once carried out dissolution dissociation is made to pile up, and checks a smooth removal operation of a paint film conversely, and suction exhaust air is carried out, so that there are many flow rates of a solvent increases, the amount of the air by which part suction is carried out decreases, and it is thought that the film removal engine performance falls as a result. Therefore, by the two pass eye, it is thought by lessening the supply flow rate of the solvent by the side of a rear face that displacement is made [many] and the removal engine performance of the high film is obtained. And if it does in this way, it is effective in the ability to optimize and reduce the consumption of a solvent.

[0054] It is desirable to, maintain a solvent supply flow rate at fixed level on the other hand at the front-face side of a substrate. It is because a part of residual paint film will come to ooze out to a removal field in the boundary part of the removal field of a paint film, and a residue field about the reason if suction exhaust air is continued in the condition that a solvent is not supplied to the front-face side of a substrate at all.

[0055] Furthermore, as for the sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face in a two pass eye, and a rear face, it is desirable that it is fewer than the sum total of the flow rate of the solvent supplied to the periphery section by the side of the front face in an one-pass eye and a rear face. The reason is that the bad influence by stagnation of an excessive solvent is avoided like the above, and the air content attracted is made [many], and the high removal engine

performance is secured, and it can reduce the consumption of a solvent.
[0056] Moreover, since there are few membranous amounts, as for a rear-face side, it is desirable to lessen the solvent supply flow rate by the side of a rear face compared with the front-face side of a substrate from the point of preventing stagnation of the dissolved film.
[0057] or [in addition , / that this invention be the die length to which the die length of not only the equipment of the type which scan the solvent discharge part where the suction exhauster style be put together but a solvent discharge part cover the edge (a shorter side or long side) of a substrate , a scan can apply it also to unnecessary equipment and it supply the time amount solvent which be in front flesh side both sides of a substrate in that case , and it lessen the flow rate of the solvent by the side of a rear face continuously] -- or what is necessary be just to make it stop
[0058] And with the gestalt of the above-mentioned implementation, before a nozzle comes on a substrate, since suction exhaust air is carried out, it can prevent discharge and dispersing on a solvent substrate for a solvent again. After a nozzle comes on a substrate temporarily, when the regurgitation of a solvent is started, there is a possibility that the first solvent may disperse on a substrate according to causes, such as mixing of the air bubbles to a nozzle point.
[0059] With the gestalt of the above-mentioned implementation, since supply of a stop and a solvent is suspended for suction exhaust air after a nozzle separates from on a substrate, the contamination on a substrate can be prevented further again. If a nozzle stops exhaust air in the condition of being located on a substrate, there is a possibility that a back flow may take place from a suction exhaust air way, and a solvent and a melt may carry out the reattachment on a substrate. However, supply of a solvent may be stopped when a nozzle is on a substrate about a rear-face side in this case.
[0060]
[Effect of the Invention] melting capacity [as opposed to / according to this invention as mentioned above / a paint film] -- being low (insurance solvent) -- since an unnecessary paint film is removable from the periphery section of a substrate even if it is the case where it uses, a throughput will not fall substantially.

[Translation done.]

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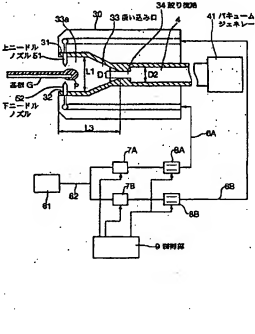
最終頁に続く

(54)【発明の名称】　薄膜除去方法及びその装置

(57)【要約】

【課題】　基板の縁部の不要なレジスト膜を除去するにあたり、レジストに対する溶解能力の低い溶剤（安全性の高い溶剤）を用いても除去処理のスループットの低下を抑えること。

【解決手段】　保持台２に基板Ｇを保持し、基板Ｇの縁部の表面側及び裏面側と夫々対向する上下ニードルノズル５１、５２を備えた溶剤吐出部３により、前記縁部に沿ってスキャンし、１回目のスキャン時（１パス目）には表面側及び裏面側に独立に所定量の溶剤を供給する。次いで２回目のスキャン時には、例えば表面側の溶剤の供給量は１パス目と同じとし、裏面側の溶剤の供給量を１回目の供給量より少なくするかあるいは溶剤の供給を停止する。



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【特許請求の範囲】

【請求項１】　薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、

（ａ）基板の表面側及び裏面側の夫々の周縁部に独立に溶剤を供給する工程と、

（ｂ）前記基板の表面側の周縁部に溶剤を供給すると共に前記基板の裏面側の周縁部に対しては前記工程（ａ）で裏面側に供給した流量よりも少ない流量で溶剤を供給するかまたは溶剤の供給を停止する工程と、を具備することを特徴とする薄膜除去方法。

【請求項２】　前記工程（ｂ）における基板の表面側及び裏面側の周縁部に供給する溶剤の流量の合計は、前記工程（ａ）における基板の表面側及び裏面側の周縁部に供給する溶剤の流量の合計よりも少ないことを特徴とする請求項１記載の薄膜除去方法。

【請求項３】　前記工程（ａ）及び（ｂ）のうち少なくとも一方において、基板の周縁部の側方かつ外方から溶剤及び溶解物を吸引排出することを特徴とする請求項１記載の薄膜除去方法。

【請求項４】　前記基板は矩形形状をなし、前記工程（ａ）及び（ｂ）のうち少なくとも一方において、溶剤が供給される基板上の位置を基板の辺に沿って移動させ、当該溶剤供給位置が基板の隅角部の領域にあるときには当該溶剤供給位置の移動速度を遅くすることを特徴とする請求項１記載の薄膜除去方法。

【請求項５】　前記基板は矩形形状をなし、前記工程（ａ）及び（ｂ）のうち少なくとも一方において、溶剤が供給される基板上の位置を基板の辺に沿って移動させ、当該溶剤供給位置が基板の隅角部の領域にあるときには溶剤の供給流量を増大させることを特徴とする請求項１記載の薄膜除去方法。

【請求項６】　薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、

前記基板の裏面側の周縁部に対しては表面側に供給する溶剤の流量よりも少ない流量で溶剤を供給することを特徴とする薄膜除去方法。

【請求項７】　薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、

溶剤吐出部から溶剤を吐出させると共に吸引排出機構により溶剤を吸引しながら、前記溶剤吐出部及び吸引排出機構を相対的に基板の周縁部に対して接近させる工程と、

次いで前記溶剤吐出部から基板の周縁部に溶剤を供給しながら前記吸引排出機構により溶剤及び溶解物を吸引排出する工程と、

その後前記溶剤吐出部から溶剤を吐出させると共に吸引排出機構により溶剤を吸引しながら、前記溶剤吐出部及び吸引排出機構を相対的に基板の周縁部に対して離間させる工程と、

を具備することを特徴とする薄膜除去方法。

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【請求項８】　薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する装置において、

前記基板の表面側及び裏面側の夫々の周縁部に独立に溶剤を供給する溶剤吐出部と、

前記溶剤吐出部から表面側及び裏面側に共に供給するか、あるいは前記溶剤吐出部から基板の表面側のみに溶剤を供給するか、を選択的に切り換える制御部と、を具備することを特徴とする薄膜除去装置。

【請求項９】　基板の側方かつ外方に溶剤及び溶解物を吸引排出するための開口を有する吸引排出路と、

この吸引排出路に設けられた絞り流路と、

を具備することを特徴とする請求項８記載の薄膜除去装置。

【請求項１０】　前記吸引排出路は、前記開口から前記絞り流路に向けて徐々に狭くなることを特徴とする請求項８記載の薄膜除去装置。

【請求項１１】　前記吸引排出路は、前記絞り流路の下流側に当該絞り流路の断面積よりも大きな断面積を有する流路を備えたことを特徴とする請求項８記載の薄膜除去装置。

【請求項１２】　薄膜が形成された矩形形状の基板の周縁部の不要な膜を除去する装置において、

前記基板を水平状態で保持する基板保持部と、

前記基板保持部に保持された基板の前記薄膜の裏面両面と側端とを間隔を介して囲むと共に、当該基板の一辺に沿って基板と相対的に移動可能に設けられた溶剤吐出部と、

前記溶剤吐出部に基板の一辺に沿って設けられ、前記薄膜を溶解させるための溶剤を基板の縁部に供給するための溶剤吐出口と、

前記溶剤吐出部の基板の側端の側方側に設けられ、溶剤及び溶解による薄膜の溶解物を吸引して排出するための吸引排気路と、を備え、

前記溶剤吐出部は、前記溶剤吐出口から毎分３０ｃｃ以上の流量で溶剤が供給されると共に、前記溶剤吐出口から供給される溶剤の基板上の流路の当該基板の一辺に沿った長さが５０ｍｍ以上であることを特徴とする薄膜除去装置。

【請求項１３】　吸引排気路の先端開口側に向けて徐々に広くなるようなラッパ状に形成されていることを特徴とする請求項１２記載の薄膜除去装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、例えば表面にレジスト膜が形成された角型のＬＣＤ基板の縁部の不要なレジスト膜を除去するための薄膜除去装置に関する。

【０００２】

【従来の技術】一般に、液晶表示ディスプレイ（ＬＣＤ）装置の製造工程においては、ＬＣＤ基板（ガラス基板）上に例えばＩＴＯ（Ｉｎｄｉｕｍ　Ｔｉｎ　Ｏｘｉ

ｄｅ）の薄膜や電極パターン等を形成するために、半導体製造工程において用いられるものと同様なフォトリソグラフィ技術を用いて回路パターン等を縮小してフォトレジストに転写し、これを現像処理する一連の処理が施される。

【０００３】上記のような処理を行う場合、例えばレジスト膜の形成方法として、角形のＬＣＤ基板（以下に基板という）を、処理容器内に配設される保持手段例えばスピンチャック上に載置固定した状態で、処理容器の開口部を蓋体で閉止して、処理容器とスピンチャックを回転させ、例えばこの基板上面の中心部に溶剤と感光性樹脂とからなるレジスト液を滴下し、そのレジスト液を基板の回転力と遠心力とにより基板中心部から周縁部に向けて放射状に拡散させて塗布する塗布膜形成方法が知られている。

【０００４】この塗布処理の際、塗布直後における膜厚は均一であっても、回転が停止して遠心力が働かなくなった後や時間が経つに従い、表面張力の影響で基板周縁部でレジスト液が盛り上がるように厚くなるという現象や、レジスト液が基板の下面周縁部にまで回り込んで不要な膜が形成されるという現象が発生する。このように基板の周縁部に不均一な厚い膜が形成されていると、集積回路パターン等の現像時に周縁部のレジストが完全には除去されずに残存することになり、その後の基板の搬送工程中にその残存したレジストが剥がれ、パーティクル発生の原因となる。

【０００５】そこで従来では、基板の表面にレジスト液等を塗布した後、基板の周縁部の不要な塗布膜を除去する処理が行われている。この処理の方法としては、例えば図９に示すように、基板Ｇの４片の縁部に、夫々除去ノズル１１（１１ａ，１１ｂ，１１ｃ，１１ｄ）によりレジスト膜の溶解するための溶剤を噴射するという方法が知られている。

【０００６】除去ノズル１１は、図１３の断面図及び図１４の平面図に示すように、例えば略コ字状に形成されて、その内部の処理空間Ｓに基板Ｇを配置し、ニードルノズル１２ａ，１２ｂから基板Ｇの上下両面に溶剤を夫々吹き付けるようになっており、溶解されたレジスト膜と溶剤とは基板Ｇの例方に設けられた排気路１３を介して外部に排出されるように構成されている。

【０００７】ここで除去ノズル１１の処理空間Ｓは、高さａが３．５mm、奥行きｂが２７mm、幅ｃが３０mmに設定されており、排気路１３は内径が９mmに設定されている。また除去ノズル１１には、開口径０．２６mmの４本のニードルノズル１２ａと４本のニードルノズル１２ｂとが夫々４mm間隔で、基板Ｇの縁部から３～４mm内側の位置にレジスト除去液を噴射するように取り付けられている。なおニードルノズル１２ａ，１２ｂの先端から基板Ｇまでの距離ｅ１，ｅ２は夫々１．０mm、２．０mm程度に設定されている。

【０００８】そしてこの除去ノズル１１によりレジスト膜を除去する際には、先ず載置台１４上に基板Ｇを吸着保持させ、２０ｃｃ／分の流量で溶剤を吹き付けながら、除去ノズル１１を基板Ｇの端辺に沿って例えば６０mm／秒の速度で夫々１往復半移動させることにより３回スキャンさせ、端辺側の不要なレジスト膜を除去している。

【０００９】

【発明が解決しようとする課題】ところで上述の方法では、従来からレジスト膜を除去するための溶剤として、酢酸ブチル（ＮＢＡ）やメチルエチルケトン（ＭＥＫ）等を用いていたが、ＬＣＤ基板の量産工場では溶剤が作業雰囲気に満ちる量が多くなることから、人体への悪影響が少ない安全な溶剤を使用する傾向が高まりつつある。

【００１０】ここで前記安全な溶剤としては、ポリプレングリコールモノメチルエーテル（ＰＧＭＥ）とポリプレングリコールモノメチルエーテルアセテート（ＰＧＭＥＡ）とを、ＰＧＭＥ：ＰＧＭＥＡ＝３：７の割合で混合したＯＫ７３シンナーや２ヘプタノン等の、例えば沸点が１４０℃以上と高く、揮発性が少ない溶剤を用いることができる。

【００１１】しかしながらこれらの溶剤のうち、ＯＫ７３シンナーは、レジスト膜の溶解能力が従前のものよりも小さいため従来の溶剤よりも除去性能が悪く、除去ノズル１１を３回スキャンさせただけではレジストを完全に除去することは困難であった。このため除去ノズル１１のスキャン回数を増やさなければならなくなるが、この際従にスキャン速度を大きくしたとしても、除去処理に要する時間は従来よりも長くなってしまい、この結果レジスト膜の形成処理全体のスループットが悪くなってしまうという問題があった。

【００１２】本発明はこのような事情の下になされたものであり、その目的は、薄膜を溶解させる溶剤を用いて基板の縁部の不要な薄膜を除去するにあたり、溶解能力の低い溶剤（安全溶剤）を用いても当該薄膜の除去処理のスループットの低下を抑えることができる技術を提供することにある。

【００１３】

【課題を解決するための手段】請求項１の発明は、薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、（ａ）基板の表面側及び裏面側の夫々の周縁部に独立に溶剤を供給する工程と、（ｂ）前記基板の表面側の周縁部に溶剤を供給すると共に前記基板の裏面側の周縁部に対しては前記工程（ａ）で裏面側に供給した流量よりも少ない流量で溶剤を供給するかまたは溶剤の供給を停止する工程と、を具備することを特徴とする。

【００１４】この場合より具体的には、例えば次のような手法とすることができる。前記工程（ｂ）における基

板の表面側及び裏面側の周縁部に供給する溶剤の流量の合計は、前記工程（ａ）における基板の表面側及び裏面側の周縁部に供給する溶剤の流量の合計よりも少ない。前記工程（ａ）及び（ｂ）のうち少なくとも一方において、基板の周縁部の側方かつ外方から溶剤及び溶解物を吸引排出する。前記基板は矩形形状をなし、前記工程（ａ）及び（ｂ）のうち少なくとも一方において、溶剤が供給される基板上の位置を基板の辺に沿って移動させ、当該溶剤供給位置が基板の隅角部の領域にあるときには当該溶剤供給位置の移動速度を速くするかまたは溶剤の供給流量を増大させる。

【００１５】請求項６の発明は、薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、前記基板の裏面側の周縁部に対しては裏面側に供給する溶剤の流量よりも少ない流量で溶剤を供給することを特徴とする。

【００１６】請求項７の発明は、薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する方法において、溶剤吐出部から溶剤を吐出させると共に吸引排出機構により溶剤を吸引しながら、前記溶剤吐出部及び吸引排出機構を相対的に基板の周縁部に対して接近させる工程と、次いで前記溶剤吐出部から基板の周縁部に溶剤を供給しながら前記吸引排出機構により溶剤及び溶解物を吸引排出する工程と、その後前記溶剤吐出部から溶剤を吐出させると共に吸引排出機構により溶剤を吸引しながら、前記溶剤吐出部及び吸引排出機構を相対的に基板の周縁部に対して離間させる工程と、を具備することを特徴とする。

【００１７】本発明の装置（請求項８）は、薄膜が形成された基板の周縁部の不要な膜を溶剤により溶解して除去する装置において、前記基板の表面側及び裏面側の夫々の周縁部に独立に溶剤を供給する溶剤吐出部と、前記溶剤吐出部から表面側及び裏面側に共に供給するか、あるいは前記溶剤吐出部から基板の表面側のみに溶剤を供給するか、を選択的に切り換える制御部と、を具備することを特徴とする。

【００１８】この場合基板の側方かつ外方に溶剤及び溶解物を吸引排出するための開口を有する吸引排出路と、この吸引排出路に設けられた絞り流路と、を具備することが好ましい。また前記吸引排出路は、前記開口から前記絞り流路に向けて徐々に狭くなることが好ましく、更に前記吸引排出路は、前記絞り流路の下流側に当該絞り流路の断面積よりも大きな断面積を有する流路を備えることが好ましい。他の発明の装置（請求項１.２）は、薄膜が形成された矩形形状の基板の周縁部の不要な膜を除去する装置において、前記基板を水平状態で保持する基板保持部と、前記基板保持部に保持された基板の周縁部の表裏両面と側端とを開隔を介して囲むと共に、当該基板の一辺に沿って基板と相対的に移動可能に設けられた溶剤吐出部と、前記溶剤吐出部に基板の一辺に沿って設けられ、前記隙隔を溶解させるための溶剤を基板の縁部に供給するための溶剤吐出口と、前記溶剤吐出部の基板の側端の側方側に設けられ、溶解及び溶剤による薄膜の溶解物を吸引して排出するための吸引排気路と、を備え、前記溶剤吐出部は、前記溶剤吐出口から毎分３０ｃｃ以上の流量で溶剤が供給されると共に、前記溶剤吐出口から供給される溶剤の基板上の流路の当該基板の一辺に沿った長さが５０ｍｍ以上であることを特徴とする。この場合吸引排気路の先端側は先端開口側に向けて徐々に広くなるようなラッパ状に形成されていることが好ましい。

【００１９】

【発明の実施の形態】本発明は、薄膜除去装置の溶剤吐出部の形状の最適化を図ることにより、薄膜例えばレジスト膜の除去性能を高め、当該レジスト膜の除去処理のスループットを向上させるものである。この際本発明者らは、種々のレジスト膜の溶剤のうち、最も除去能力の低いＯＫ７３シンナーの除去性能を向上させる溶剤吐出部の構造を開発すれば、種々の溶剤に適用することができる汎用性の高い装置が得られると考え、本発明を完成するに至った。

【００２０】先ず図１～４に基づいて本発明の薄膜除去装置の一実施の形態について説明する。この装置は、基板Ｇ例えば長方形のＬＣＤ基板の下面を真空吸着して当該基板Ｇを水平（本願でいう水平とはほぼ水平も含む）に保持する基板保持部をなす保持台２と、この保持台２に保持された基板ＧのＭ辺の縁部（端縁から多少中央へ寄った位置までの領域）に溶剤を吹き付けるための４つの第１～第４の溶剤吐出部３（３ａ～３ｄ）とを備えており、これら溶剤吐出部３は、基板Ｇの幅方向（ｘ方向）、長さ方向（ｙ方向）、高さ方向（ｚ方向）に移動自在に設けられている。

【００２１】前記溶剤吐出部３は、互に対向する上面部３１及び下面部３２と、これら上面部３１及び下面部３２に夫々設けられた、溶剤吐出用の上ニードルノズル５１及び下ニードルノズル５２と、上面部３１及び下面部３２の基端側においてこれらの間の空間３３ａに臨むように開口し、その開口部からラッパ状に縮径するように形成された吸引排気路の一部をなす吸い込み口３３と、この吸い込み口３３の基端側に連通する絞り流路（オリフィス流路）３４と、この絞り流路３４に連通する例えば断面形状が円形の定常流路４と、を備えており、上面部３１及び下面部３２から定常流路４の一部は、外装部をなすブロック３０により覆われている。

【００２２】前記上ニードルノズル５１、（下ニードルノズル５２）はブロック３０内に形成された流路５１ａ（５２ａ）を介して例えばチューブからなる溶剤供給路６Ａ（６Ｂ）に接続されている。これら溶剤供給路６Ａ、６Ｂは、溶剤供給源６１に一端が連通する共通の溶剤供給路６２から分岐しており、分岐ラインである溶剤

供給路６Ａ（６Ｂ）には、流量制御弁７Ａ（７Ｂ）及びエアオペレーションバルブ８Ａ（８Ｂ）がこの順に設けられている。なお流量制御弁７Ａ、７Ｂ及びエアオペレーションバルブ８Ａ（８Ｂ）の動作は制御部９によって夫々独立に制御できるようになっている。

【００２３】上下のニードルノズル５１、５２は図３に示すように夫々４本ずつ設けられ、上ニードルノズル５１の吐出口と下ニードルノズル５２の吐出口とは一直線上に向き合わないように千鳥状に配列されている。そして図２に示すように上下にニードルノズル５１、５２の間に基板Ｇの周縁部を位置させると、上ニードルノズル５１の吐出口は基板Ｇの表面に対面し、下ニードルノズル５２の吐出口は基板Ｇの裏面に対面する。この場合上下ニードルノズル５１、５２の吐出口は基板Ｇの端縁から例えば３～４ｍｍ中央に寄った位置に対向する。なお上ニードルノズル５１の吐出口から基板Ｇの表面までの距離は例えば１．０ｍｍに、下ニードルノズル５２の吐出口から基板Ｇの裏面までの距離は例えば約１．０ｍｍに夫々設定される。また上下ニードルノズル５１、５２の吐出口の内径は約０．２６ｍｍである。

【００２４】前記上面部３１及び下面部３２の間の空間３３ａ、ラッパ状の吸い込み口３３、絞り流路３４及び定常流路４は溶剤を吸引して回収するための吸引排気路をなすものであり、定常流路４にはバキュームジェネレータ（真空排気装置）４１が設けられている。なお吸引排気路を構成する部材は吸引排気機構に相当する。この場合空間３３ａの高さつまり上面部３１と下面部３２との離間距離Ｌ１は５０～１００ｍｍに、幅Ｌ２は２５～１００ｍｍに夫々設定することが望ましい。また上面部３１、下面部３２の先端から絞り流路３４の入り口までのＸ方向距離Ｌ３は２５～２００ｍｍに設定することが好ましい。前記絞り流路３４は角型をなしており、その縦径Ｄ１は６～１１ｍｍに、横径Ｄ３は１１～６０ｍｍに設定することが好ましい。また定常流路４の径Ｄ２は１２ｍｍ以上とすることが好ましい。更にまたラッパ状の吸い込み口３３の先端開口部（吐出開口部）は上面部３１（下面部３２）の先端から例えば約４ｍｍ奥に入ったところに位置している。

【００２５】このような薄膜除去装置では、レジスト液が例えばスピンコーティングにより塗布されて表面にレジスト膜が形成された基板Ｇが、図示しない搬送アームにより搬入され（工程Ｓ１）、保持台２上に載置されて吸引保持される（工程Ｓ２）。

【００２６】溶剤吐出部３ａ～３ｄをホーム位置から使用位置に向けて移動させはじめるとともに、バキュームジェネレータ４１により各溶剤吐出部３ａ～３ｄ内の吸引排気をそれぞれ開始する（工程Ｓ３）。上下ノズル５１、５２から３０ｃｃ／分の流量で溶剤を夫々吐出開始する（工程Ｓ４）。溶剤を吐出させながら全ての溶剤吐出部３ａ～３ｄを基板Ｇの周縁部に接近させ、図２に示すように各ノズル５１、５２を基板Ｇの周縁部に位置させる（工程Ｓ５）。引き続き図１に示すように溶剤吐出部３ａ～３ｄを基板Ｇの各辺Ｇ１、Ｇ２、Ｇ３、Ｇ４に沿ってスキャン移動させ、１パス目の塗膜除去動作を開始する（工程Ｓ６）。第１及び第３の溶剤吐出部３ａ、３ｃにより基板短辺Ｇ１、Ｇ３の周縁部から塗膜Ｐ（図２参照）が溶解除去されるとともに、第２及び第４の溶剤吐出部３ｂ、３ｄにより基板長辺Ｇ２、Ｇ４の周縁部から塗膜Ｐが溶解除去される。レジスト溶解物および余剰の溶剤は吸引排気路を通って、つまり空間３３ａ、吸い込み口３３、絞り流路３４及び定常流路４を通ってバキュームジェネレータ４１に吸引排気される。

【００２７】第１及び第３の溶剤吐出部３ａ、３ｃが基板短辺Ｇ１、Ｇ３の終端（コーナー部）に到着すると、これらのスキャン移動を停止させる（工程Ｓ７）。なお、第１及び第３の溶剤吐出部３ａ、３ｃが短辺Ｇ１、Ｇ３の終端に近くなるに従って、スキャン移動速度を遅くするか又は溶剤供給量（流量）を増大させるようにするほうが望ましい。基板Ｇのコーナ部の塗膜は他の部位よりも厚くなっているため、このようにすると塗膜の単位面積当りの溶剤供給量が多くなるため、基板Ｇのコーナー部から厚い塗膜９ｂが除去されやすくなる。次いで、溶剤を吐出しながら第１及び第３の溶剤吐出部３ａ、３ｃを後退させ、基板Ｇの短辺Ｇ１、Ｇ３からノズル５１、５２を離間させる（工程Ｓ８）。次いで、短辺Ｇ１、Ｇ３におけるノズル５１、５２からの溶剤の吐出を停止させ（工程Ｓ９）、さらに短辺Ｇ１、Ｇ３における吸引排気を停止させる（工程Ｓ１０）。

【００２８】第２及び第４の溶剤吐出部３ｂ、３ｄにおいても基板長辺Ｇ２、Ｇ４の終端に近くなるに従ってスキャン移動速度を遅くするか又は溶剤供給量を増大させるようにし、これらが長辺Ｇ２、Ｇ４の終端に到達したところで１パス目の塗膜除去が終了する（工程Ｓ１１）。またノズル５１、５２を基板Ｇの長辺Ｇ２、Ｇ４から離間させた後、溶剤の吐出を停止し、吸引排気を停止する。

【００２９】ここで溶剤吐出部３ａ、３ｃは、短辺Ｇ１、Ｇ３に沿った軸線つまりＸ方向に伸びるライン上に沿って移動しながら基板Ｇの周縁部に接近し、また当該ライン上に沿って基板Ｇの周縁部から離間する。即ち溶剤吐出部３ａ、３ｃの一連の動きは一直線に沿ったものになる。仮に溶剤吐出部３ａ、３ｃをＹ方向に移動して基板Ｇの周縁部の角隅部に接近させ、次いでＸ方向に移動し、また基板ＧからＹ方向に離間させると、溶剤吐出部３ａ、３ｃの動きが直角になってしまうため、その直角点において溶剤吐出部３ａ、３ｃが一旦停止した格好になって溶剤が１点で集中的に供給されるので溶剤や溶解物が基板上に飛散するおそれがある。これに対して溶剤吐出部３ａ、３ｃを一直線に沿って動かすことにより、こうした不具合が回避される。なお溶剤吐出部３ｂ、３

dについても同様に長辺G2、G4に沿ったライン（Y方向に伸びるライン）に沿って一直線上に動く。

【0030】その後溶剤吐出部3a、3cにおける吸引排気を再開する（工程S12）と共に、溶剤生出部3a、3cにおける溶剤の吐出を再開する（工程S13）。ノズル51、52から溶剤を吐出させながら第1及び第3の溶剤吐出部3a、3cを基板Gの周縁部にそれぞれ接近させ（工程S14）、図1に示すように各ノズル51、52を基板Gの周縁部に位置させる。

【0031】次いで溶剤吐出部3a～3dのスキャンを行うための図示しないモータ駆動を逆向きに切り替え、溶剤吐出部3a～3dを基板の各辺G1、G2、G3、G4に沿って1パス目の移動速度と同じ速度でスキャン移動させ、2パス目の塗膜除去動作を開始する（工程S15）。なお第1及び第3の溶剤吐出部3a、3cは基板Gの短辺G1、G3を行き過ぎたところで折り返し、第2及び第4の溶剤吐出部3b、3dは基板の長辺G2、G4を行き過ぎたところでそれぞれ折り返す。すなわち、第1～第4の溶剤吐出部3a～3dの折り返し点は基板Gの外方に位置する。

【0032】第1及び第3の溶剤吐出部3a、3cが基板短辺G1、G3の終端（コーナー部）に到着すると、これらのスキャン移動を停止させる（工程S16）。なおこの場合も溶剤吐出部3a、3cが前記終端に近くなるに従ってスキャンの移動速度を遅くするかまたは溶剤供給量を増大させる。次いで、溶剤を吐出しながら第1及び第3の溶剤吐出部3a、3cを後退させ、基板Gの短辺G1、G3からノズル51、52を離間させる（工程S17）。次いで、短辺G1、G3におけるノズル51、52からの溶剤の吐出を停止させ（工程S18）、さらに短辺G1、G3における吸引排気を停止させる（工程19）。

【0033】2パス目の塗膜除去動作においては、下ノズル52からの溶剤の吐出を停止させるか又は溶剤の吐出量を例えば10cc/分まで大幅に減少させる。なお上ノズル51からの溶剤の吐出量は30cc/分をそのまま維持する。

【0034】第2及び第4の溶剤3b、3dが基板長辺G2、G4の終端に近くなるに従ってスキャン移動速度を遅くするかまたは溶剤供給量を増大させるようにし、これらが長辺G2、G4の終端に到達したところで溶剤の吐出動作を停止させ、2パス目の塗膜除去を終了させる（工程S20）。次いで溶剤吐出部3a～3dの吸引排気動作をすべて停止させ（工程S21）、全ての溶剤吐出部3a～3dを使用位置からホーム位置に待避させる（工程S22）。しかる後保持台2を上昇させ、基板Gの吸着を解除する（工程S23）。そして、図示しない搬送アームにより基板Gを当該薄膜除去装置から搬出する（工程S24）。以上の工程S1から工程S24までの1サイクルに要する処理時間は、約3.4秒間である。

【0035】続いて本発明を完成するに至った経緯について説明する。本発明者らは、既述のようにOK73シンナーを溶剤として用いて、溶剤吐出部3の形状の最適化を図り、レジスト膜の除去性能を高めることとしたが、この膜先ず溶剤の量が多くなればレジストの除去性能が向上すると考え、溶剤の流量の最適化を図ることとした。

【0036】このため上述の溶剤吐出部3を備えた薄膜除去装置を用いて、溶剤であるOK73シンナーの吐出流量を変えて、650mm×650mmの大きさの基板Gの除去処理を行った。ここで溶剤吐出部3の幅（詳しくは上面部31、下面部32の先端縁の幅L2）は30mm、定常流路4の径D2は9mm、レジスト膜の厚さは約7μmとし、バキュームジェネレータ42に2．5～3kgf/cm²の圧力でエアを供給して定常流路4内の負圧を－18～－20mmHgとした。

【0037】そして溶剤吐出部3を基板Gの長辺の走方向に沿って、60mm/秒の速度で3回スキャンさせて除去処理を行ない、処理終了後にレジスト膜（塗膜P）の除去性能を確認した。ここでレジスト膜の除去性能は、処理終了後に基板Gの表面と端面とをアセトンを含ませた布で拭き取り、当該布に付着したレジスト膜の量により、基板G上にどの程度レジスト膜が残存しているかを確認することにより行った。

【0038】この結果を図6に示すが、図中レジスト膜の除去性能の評価の内、◎はレジスト膜が完全に除去された状態、○はレジスト膜がほとんど除去された状態、△はレジスト膜が残存している状態を夫々示している。この結果より溶剤の流量が多くなれば、レジスト膜の除去性能が高くなることが認められ、流量が50cc/分と多くなれば、3回の（3パス）スキャンによりレジスト膜をほとんど除去することができることが認められた。

【0039】但し実験の際、基板Gの表面を目視で観察した所、溶剤の流量が多くなると、溶剤とレジスト膜の溶解物とが吸引排気されずに、基板G上に滞留して残ってしまい、基板G表面が乾かないで濡れた状態となってしまうという現象が見られた。このためこれらの滞留物がレジスト膜の除去を妨げていると考え、前記滞留物をいかに吸引排気するかを検討した。

【0040】先ず流量の増加に伴い、溶剤吐出部の先端部の幅L2を大きくすることにより、基板G上に供給される溶剤の当該基板上の流路の幅を大きくすることに着目した。このため上述の溶剤吐出部3を備えた薄膜除去装置を用い、他の条件は同様として溶剤吐出部の先端部の幅L2と溶剤の流量とを変えて除去処理を行ない、処理終了後に基板Gに溶剤とレジスト膜の溶解物が残存しているか否かを同様の方法で確認した。

【0041】ここでニードルノズル51から基板G上に供給された溶剤は、図3に一点鎖線で示すように、ニー

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ドルノズル51の先端と対応する基板G上の位置から同心円状に拡がりながら基板G上から吸い込みロ33内に吸い込まれ、定常流路4に向けて流れていく。つまりここでいう溶剤の流路の幅とは、基板G上に同心円状に拡がった溶剤の流路の幅方向（y方向）の長さを意味しており、この図では溶剤吐出部3の先端部の幅L2に相当する。

【0042】図7には前記幅L2と溶剤の供給流量Qとの最適化を計るために行った実験結果を示す。これによより溶剤の流量が同じであれば、溶剤吐出部の幅L2が大きくなる程、レジスト膜（塗膜P）の除去性能が高くなることが認められ、特に幅L2が50mm以上であれば、溶剤の流量が30cc／分程度であっても、レジスト膜をほとんど除去できることが確認された。このように溶剤吐出部3の幅L2を大きくするとレジスト膜の除去性能が高まるのは、溶剤の流路の幅が大きくなって排気領域が大きくなるので、より排気しやすくなるからであると推察される。またこの実験を目視で観察することにより、溶剤吐出部の幅L2が50mmであれば、基板G上に同心円状に拡がった溶剤の流路の幅方向（y方向）の長さは50mm以上であることが確認された。

【0043】しかしながら溶剤吐出部3の幅L2を50mm以上大きくしても、多少基板G上に残渣が観察されたことから、次に吸引圧力を大きくして溶剤やレジスト膜の溶解物の吸引排気力を高めることに着目した。このため上述の溶剤吐出部3を備えた薄膜除去装置を用い、吸引圧力を変えて前記基板Gの除去処理を行った。ここで溶剤吐出部3の幅L2は50mm、溶剤の流量は30cc／分とし、他の条件は同様として除去処理を行ない、処理終了後に基板Gに溶剤とレジスト膜の溶解物が残存しているか否かを同様の方法で確認した。

【0044】ところがバキュームジェネレータ41に供給するエアの圧力を3．5～4kgf／cm²として定常流路4内の差圧を－23～－26mmHgと大きくしても基板G上に前記残渣が観察された。これは吸引圧力だけを大きくしても排気速度が変わるだけであって排気領域は大きくならないため、定常流路4に近い領域では吸引排気力が大きいが、遠い領域では吸引排気力が小さくなってしまい、当該遠い領域では溶剤やレジスト膜の溶解物が吸引排気されにくいためであると推察される。

【0045】そこで続いて定常流路4の径D2を大きくすることにより、排気領域を大きくすることに着目した。このため上述の溶剤吐出部3を備えた薄膜除去装置を用い、定常流路4の径D2を変えて、前記基板Gの除去処理を行った。ここで溶剤吐出部3の先端部の幅L2は50mm、溶剤の流量は30cc／分、定常流路4の差圧は－35～－40mmHgとし、他の条件は同様として除去処理を行ない、処理終了後に基板Gに溶剤とレジスト膜の溶解物が残存しているか否かを同様の方法で

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【0046】図8に絞り流路34の径（オリフィス内径）D1を一定値（D1＝9mm）として定常流路4の径D2を種々変更した場合における塗膜除去性能につき調べた結果を示す。また、図9に定常流路4の径D2を一定値（D2＝12．6mm）として絞り流路34の径D1を種々変更した場合における塗膜除去性能につき調べた結果を示す。これらの結果から絞り流路34径D1を9mmとし、定常流路4の径D2を12．6mmとする組み合わせが最適であることが判明した。

【0047】上述のように塗膜除去性能は吸引排気時における空気の流速の影響を受けるため、排気空気の流速を最適化することが肝要である。上述の実施の形態では、吸引排気路の途中に絞り流路34を形成すると共にその下流側は拡大して定常流路4に連通しているため、絞り流路34の前後の圧力差が高く、このため排気の流速が高まり、塗膜除去性能が向上する。そして基板Gの周縁部に臨む領域から絞り流路34までは、徐々に断面積が狭くなるラッパ状の吸い込み口として吸引排気路を形成しているので、溶剤や溶解物が基板上や通路内で滞留することなく円滑かつ迅速に排出される。なおノズル51、52の近傍において流路を狭めた場合には、ノズル51、52の近傍自体の流路が狭くなって排気量が絶保できず、更に膜の吸い出し脈が発生し中すくなるが、本願ではこのような不具合が避けられるので有効な構造である。

【0048】さらに定常流路4内の差圧を変えて同様に除去処理を行ない、除去性能を同様の方法で確認したところ、図10に示す結果が得られ、これにより定常流路4の径D2が12mm以上であっても、定常流路4内の差圧が小さければ溶剤とレジスト膜の溶解物は吸引排気されにくいことが確認された。

【0049】さらに、2パス目の溶剤吐出量（cc／分）を基板の表面側と裏面側とで種々変えて塗膜Pの除去処理を行ない、それぞれの塗膜除去性能を同様の方法で評価したところ図11に示す結果が得られた。これから明らかなように、表面側への2パス目の溶剤供給量は1パス目のそれ（30cc／分）と同じに維持しつつ、裏面側への2パス目の溶剤供給量を1パス目のそれより少なくするか（番号5の方法）、あるいは裏面側への溶剤供給を停止する（番号2の方法）と、塗膜除去性能が向上することが判明した。なお、番号1の方法では2パス目は1パス目と同じ条件であるが、その塗膜除去性能は番号2および番号5の方法のそれよりも劣る。また、番号3の方法では表面側への2パス目の溶剤の供給を停止し、裏面側への2パス目の溶剤供給量を2パス目のそれ（30cc／分）と同じに維持している。また、番号4の方法では表裏面ともに2パス目に溶剤を供給することなく吸引排気のみを行なっている。これらの番号3、4の方法ではいずれも塗膜Pを除去できなかった。

【0050】以上のような試行錯誤を繰り返した結果、

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溶剤としてOKシンナー等のエーテル系の溶剤を用いた場合には、溶剤吐出部3からの溶剤の吐出流量を30cc／分以上とし、溶剤の基板上の流路の幅L2を50mm以上に設定すれば、レジスト膜はほとんど除去できることが確認された。この設定流路の径D2を12mm以上とすればさらにレジスト膜の除去性能が高くなることが確認された。

【0051】続いてこの溶剤吐出部3を用いた薄膜除去装置の汎用性を確認するため、溶剤としてPGMEA（プロピレングリコールモノメチルエーテルアセテート）等のエーテル系の溶剤、酢酸ブチル（NBA）やメチルエチルケトン（MEK）、2ヘプタノンを用いて、基板Gの縁部のレジスト膜の除去処理を行ったところ、溶剤吐出部3からの溶剤の吐出流量を30cc／分以上とし、溶剤吐出部3の幅L2を50mm以上に設定すれば、いずれの溶剤でも基板縁部の不要なレジスト膜を完全に除去できることが確認され、また定常流路4の径D2を12mm以上とすれば、さらにレジスト膜の除去性能が高まることが確認された。

【0052】上述の実施の形態によれば、1パス目では基板の周縁部の表裏両面から所定流量で溶剤を供給することにより大部分のレジストを除去し、2パス目において残りのレジストを除去している。そして2パス目では裏面側の溶剤の供給流量を少なくするか溶剤の供給を停止しているので、実験例からも分かるように膜の除去性能が高い。この理由については、裏面側はレジストの量が少ないので、2パス目にて溶剤の量を多くすると一旦溶解離脱した膜が溶剤することになるが、本実施の形態のように処理することによって膜の溶解を防止できると考えられる。

【0053】更にまた薄膜除去装置は、上述のように吸引排気を伴うことが好ましい。即ち2パス目では塗膜を溶かすという作用よりも1パス目で溶解した塗膜を吸い出すという作用が強く、そのため余分な溶剤がかえって一旦溶解離脱した膜を溶留させ、塗膜の円滑な除去作用を逆に阻害し、また溶剤の流量が多い程、吸引排気される溶剤の量が多くなってその分吸引される空気の量が少なくなり、その結果膜除去性能が落ちると考えられる。従って2パス目では裏面側の溶剤の供給流量を少なくすることにより、排気量を多くして高い膜の除去性能が得られると考えられる。そしてこのようにすれば溶剤の消費量を最適化して低減させることができるという効果もある。

【0054】一方基板の表面側においては溶剤供給流量を一定レベルに保つことが望ましい。その理由については、基板の表面側に全く溶剤が供給されない状態で吸引排気を続けると、塗膜の除去領域と残量領域との境界部分において残留塗膜の一部が除去領域に染み出すようになるからである。

【0055】更に2パス目における表面側及び裏面側の

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周縁部に供給する溶剤の流量の合計は、1パス目における表面側及び裏面側の周縁部に供給する溶剤の流量の合計よりも少ないことが望ましい。その理由は、上記同様余分な溶剤の溶留による悪影響を回避し、また吸引される空気量を多くして高い除去性能を確保しかつ溶剤の消費量を低減できるからである。

【0056】また裏面側は膜の量が少ないため、基板の表面側に比べて裏面側の溶剤供給流量を少なくすることが、溶解した膜の溶留を防止するという点から好ましい。

【0057】なお、本発明は、吸引排気機構が組み合わされた溶剤吐出部をスキャンするタイプの装置に限らず、溶剤吐出部の長さが基板の縁部（短辺あるいは長辺）をカバーする長さであってスキャンが不要な装置にも適用でき、その場合には基板の表裏両面にある時間溶剤を供給し、続いて裏面側の溶剤の流量を少なくするかあるいは停止するようにすればよい。

【0058】そしてまた上述実施の形態では、ノズルが基板上に来る前から溶剤を吐出しかつ吸引排気しているので、溶剤基板上に飛散することを防止できる。仮にノズルが基板上に来てから溶剤の吐出を開始すると、ノズル先端部への気泡の混入などの原因により最初の溶剤が基板上に飛散するおそれがある。

【0059】さらにまた上述実施の形態では、ノズルが基板上から離れた後に吸引排気を止めかつ溶剤の供給を停止しているので基板上の汚染を防止できる。仮にノズルが基板上に位置している状態で排気を止めると、吸引排気筒から逆流が起こって溶剤や溶解物が基板上に再付着するおそれがある。ただしこの場合裏面側についてはノズルが基板上にあるときに溶剤の供給を止めてもよい。

【0060】

【発明の効果】以上のように本発明によれば、塗膜に対する溶解能力の低い（安全溶剤）を用いる場合でっても基板の周縁部から不要な塗膜を除去することができるので、スループットが実質的に低下しなくなる。

【図面の簡単な説明】

【図1】本発明方法の一実施の形態に用いられる薄膜除去装置を示す斜視図である。

【図2】前記薄膜除去装置に設けられた溶剤吐出部の一例を示す断面図である。

【図3】前記溶剤吐出部の一例を示す平面図である。

【図4】前記溶剤吐出部の一例を示す斜視図である。

【図5】本方法の一実施の形態を示す工程図である。

【図6】溶剤の流量の最適化を図るために行った実験の結果を示す説明図である。

【図7】前記溶剤吐出部の幅と溶剤の流量の最適化を図るために行った実験の結果を示す説明図である。

【図8】前記溶剤吐出部の吸引管の内径の最適化を図るために行った実験の結果を示す説明図である。

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【図９】前記溶剤吐出部の吸引管の内径の最適化を図るために行った実験の結果を示す説明図である。

【図１０】前記溶剤吐出部の風量の最適化を図るために行った実験の結果を示す説明図である。

【図１１】２パス目の溶剤供給流量とレジスト膜の除去性能との関係を示す説明図である。

【図１２】従来のレジスト膜の除去方法を示す工程図である。

【図１３】従来のレジスト膜の除去ノズルを示す断面図である。

【図１４】従来のレジスト膜の除去ノズルを示す平面図である。

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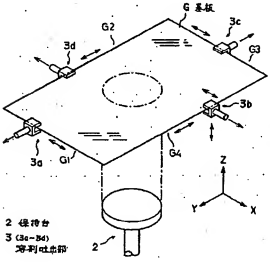
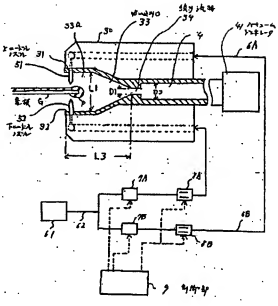
【符号の説明】

2	保持台
3（３ａ～３ｄ）	溶剤吐出部
３３	吸い込み口
３４	絞り流路
4	定常流路
４１	バキュームジェネレータ
５１、５２	ニードルノズル
７Ａ、７Ｂ	流量制御弁
9	制御部
G	基板
P	感膜

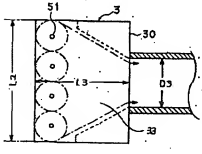
【図１】



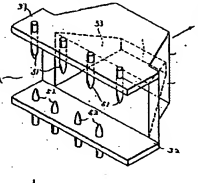
【図２】



【図３】



【図４】



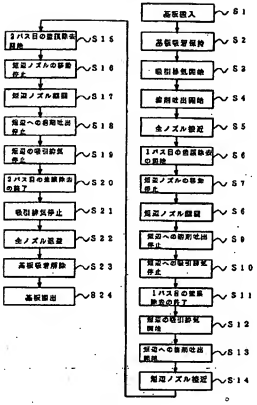
【図６】

流量（ｃｃ／分）	除去性能
5 0	○
4 0	△
3 0	△
2 0	△

33 suction

51,52 delivery

【図5】



【図7】

流量（cc／分）	除去性能 溶剤吐出開始の幅C（mm）				
	30	40	45	50	55
50	○	○	○	○	○
40	△	△	○	○	○
30	△	△	△	○	○
20	△	△	△	△	△

【図10】

エア圧力（kgf/cm²）	内径（mm） 13		12.7		12	
	差圧	除去性能	差圧	除去性能	差圧	除去性能
1.0	−12	×	−11	×	−9	×
2.0	−22	△	−21	△	−19	△
3.0	−30	○	−29	○	−27	○
4.0	−42	◎	−40	◎	−38	◎

差圧（mmAq）

【図8】

D1＝9mm	
D2（mm）	除去性能
12.7	◎
11.9	○
10.0	△

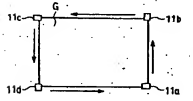
【図9】

D2＝12.6mm	
D1（mm）	除去性能
11	△
9	◎
6	△

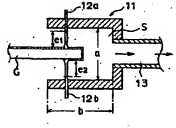
【図11】

	2パス目の塗布（cc/分） 表面	裏面	除去性能
1	30	30	△
2	30	0	◎
3	0	30	×
4	0	0	×
5	30	10	◎

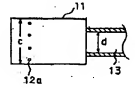
【図12】



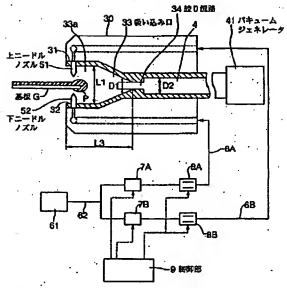
【図13】



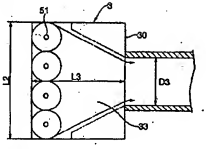
【図14】



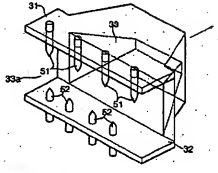
【手続補正書】
【提出日】平成１０年１１月１９日
【手続補正１】
【補正対象書類名】図面
【補正対象項目名】図２
＊【補正方法】変更
【補正内容】
【図２】



【手続補正２】
【補正対象書類名】図面
【補正対象項目名】図３
【補正方法】変更
【補正内容】
【図３】



【手続補正３】
【補正対象書類名】図面
【補正対象項目名】図４
【補正方法】変更
【補正内容】
【図４】



【手続補正４】
【補正対象書類名】図面
【補正対象項目名】図８
【補正方法】変更
【補正内容】
【図８】

D1=0mm	
D2(mm)	吸去性能
12.6	◎
11.0	○
10.0	△

【手続補正５】
【補正対象書類名】図面
【補正対象項目名】図９

【補正方法】変更
【補正内容】
【図９】

D2>12.6mm	
D1(mm)	除去性能
11	△
9	○
6	△

【手続補正６】
【補正対象書類名】図面
【補正対象項目名】図１１
【補正方法】変更
【補正内容】
【図１１】

	2パス目の流量 (cc/分)		除去性能
	表面	裏面	
1	30	30	△
2	30	0	○
3	0	30	×
4	0	0	×
5	30	10	○

フロントページの続き

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